



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

MEMORANDUM TO: Melvyn N. Leach, Chief  
Special Projects and Inspection Branch  
Division of Fuel Cycle Safety  
and Safeguards

THRU: Joseph G. Glitter, Chief *RAW for JGG*  
Special Projects Section *5/28/02*  
Special Projects and Inspection Branch, FCSS

FROM: Timothy C. Johnson  
Senior Mechanical Systems Engineer  
Special Projects Section  
Special Projects and Inspection Branch, FCSS

SUBJECT: MAY 2, 2002, MEETING SUMMARY: U.S. ENRICHMENT  
CORPORATION GAS CENTRIFUGE LEAD CASCADE PRE-  
APPLICATION MEETING ON INTEGRATED SAFETY ANALYSIS  
AND SEISMIC ISSUES

On May 2, 2002, U.S. Nuclear Regulatory Commission (NRC) staff held a pre-application meeting with U.S. Enrichment Corporation (USEC) staff to discuss integrated safety analysis and seismic issues. I am attaching the meeting summary for your use. This summary contains no proprietary or classified information.

Docket: 70-7003

Attachment: USEC Gas Centrifuge Lead Cascade  
Integrated Safety Analysis and Seismic Issues  
Meeting Summary

May 21,2002

MEMORANDUM TO: Melvyn N. Leach, Chief  
Special Projects and Inspection Branch  
Division of Fuel Cycle Safety  
and Safeguards

THRU: Joseph G. Glitter, Chief  
Special Projects Section /RA/  
Special Projects and Inspection Branch, FCSS

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OFC	SPIB*		SPIB*		SPIB*		SPIB*	
NAME	TCJohnson:dw		DHoadley		RWescott		JGlitter	
DATE	5 / 17 /02		5 / 20 /02		5/ 21 /02		5 / 21 /02	

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U.S. Enrichment Corporation Lead Cascade Integrated  
Safety Analysis and Seismic Issues Meeting Summary

Date: May 2, 2002

Place: U.S. Nuclear Regulatory Commission (NRC) Offices; Rockville, Maryland

Attendees: See Attachment 1

Purpose:

The purpose of this meeting was to discuss with the U.S. Enrichment Corporation (USEC) staff their plans for addressing integrated safety analysis (ISA) and seismic issues applicable to USEC's gas centrifuge lead cascade project.

Discussion:

Following introduction of individuals attending the meeting, USEC staff provided a general background discussion of the lead cascade project. They indicated that they would be submitting a license application under 10 CFR Part 70 for operation of up to 240 gas centrifuge machines for testing only at one of the gaseous diffusion plants. Enriched material and tails would be recombined so that no enriched product would be produced other than for sampling purposes. The lead cascade would be used to provide design, operations, and reliability information to support a decision on development of a full-scale commercial gas centrifuge facility. USEC staff indicated that although a Cooperative Research and Development Agreement has not yet been completed with the U.S. Department of Energy (DOE) for use of DOE gas centrifuge technology, USEC was still working to submit the lead cascade license application by the end of 2002.

USEC staff indicated that it plans to meet the requirements in 10 CFR 70.62 by establishing process safety information, conducting an ISA, and having a program of management measures to ensure that items relied on for safety are reliable and available when needed. USEC will prepare its ISA with a team of individuals experienced with centrifuge design and operations and with hazard, risk assessment, and criticality safety.

USEC presented a systematic plan to identify hazards and evaluate their consequences. Hazards that will be considered include standard industrial hazards, chemical hazards, radiological hazards, and nuclear criticality hazards. Standard industrial hazards will be evaluated to determine if they could initiate or contribute to radiological and chemical releases. If a hazard poses an unacceptable risk to the public or workers, potential preventive or mitigative measures will be identified.

The hazards will be evaluated by identifying initial conditions, performing an unmitigated consequence analysis, selecting controls when needed to meet the 10 CFR 70.61 performance criteria, and performing a mitigated consequence analysis. Event frequencies will primarily be estimated in a qualitative manner. USEC indicated that they will provide the rationale for any

qualitative event frequency assumptions. Uncertainties would be addressed by conservative estimates. USEC indicated that their definitions for unlikely and highly unlikely accident sequences will be in accordance with the guidance provided in "Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility," NUREG-1520. Accident sequences that are unlikely will be sequences that have a probability of occurrence of less than  $10E-4$  per event per year and accident sequences that are highly unlikely will be sequences that have a probability of occurrence of less than  $10E-5$  per event per year. Only credible events will be considered for deriving accident sequences. Non-credible external events are defined in the NUREG as events for which the frequency of occurrence can be conservatively estimated as less than once in a million years. Non-credible process deviations may be defined using more deterministic arguments.

Consequences of events would be evaluated for the public outside the controlled area, for workers inside the controlled area but outside the restricted area, and for workers inside the restricted area. For workers inside the controlled area, but outside the restricted area, USEC staff understands that these workers need to meet the 10 CFR Part 19 worker training requirements. Since the lead cascade will be located at one of the gaseous diffusion plant sites, there will be workers employed by DOE and by USEC that are located within the site controlled area but outside the restricted area of the lead cascade operation. For high consequence events, these workers will be limited to acute doses less than or equal to 100 rems. For intermediate consequence events, the environmental protection requirements in 10 CFR 70.61 apply outside the restricted area, not outside the controlled area.

For chemical releases, USEC will use the Emergency Response Planning Guidelines for chemical exposure limits. Chemical exposure limits for high, intermediate, and low consequence events were proposed for the public and workers.

For events that exceed the 10 CFR 70.61 limits, USEC will apply preventive or mitigating features to reduce the consequences within acceptable limits. The binning approach for addressing unmitigated consequence events is consistent with the guidance in NUREG-1520. Preventive or mitigating measures could include design features or administrative controls. The events would be re-evaluated assuming application of the preventive or mitigating features to demonstrate that the 10 CFR 70.61 performance criteria are met.

NRC staff indicated that the ISA approach presented appeared to satisfy NRC's needs.

USEC staff presented its approach for addressing credible external events, such as floods and earthquakes. USEC staff indicated it intended to use a 100-year flood and 250-year and 500-year return earthquakes in the ISA. NRC staff indicated that these events presented in NUREG-1520 were intended as minimum events and higher consequence events may need to be considered to demonstrate compliance with the 10 CFR 70.61 performance requirements.

USEC staff suggested that additional pre-application meetings are needed in late May to discuss the security plan submittal and in July to discuss preliminary results of the ISA and environmental report. NRC and USEC staff agreed to further discuss available dates for these meetings.

USEC's handouts are enclosed in Attachment 2.

Action Items:

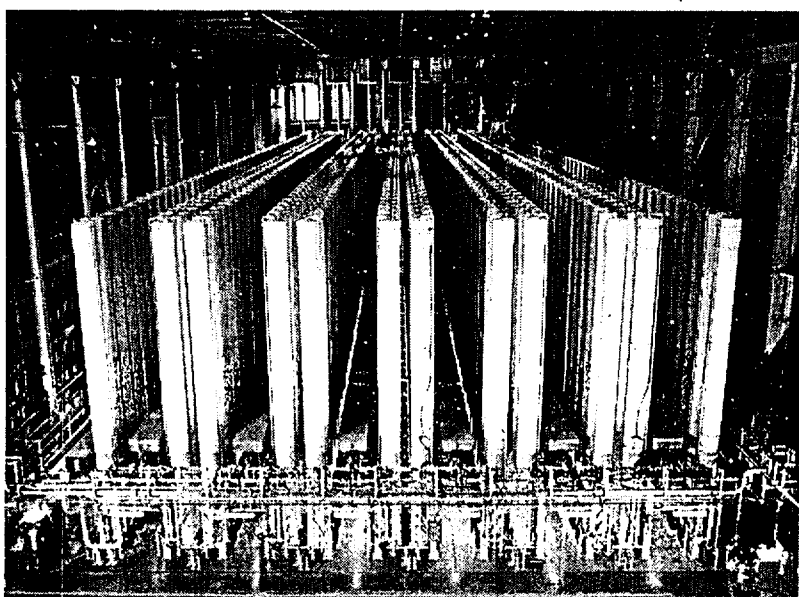
Set up pre-application meetings on the security plan and preliminary ISA and environmental report results.

Attachments: 1. Attendee list  
2. Meeting handouts

U.S. Enrichment Corporation Lead Pre-Application Meeting on  
Integrated Safety Assessments and Seismic Issues  
Date: May 2, 2002

NAME	AFFILIATION	PHONE	EMAIL ADDRESS
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Attachment 1



**USEC/NRC  
3<sup>rd</sup> Pre-Application  
Meeting for the  
Centrifuge  
Lead Cascade  
Facility**

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**NRC Headquarters**

**Rockville, Maryland**

**May 2, 2002**



# AGENDA

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- **Introduction & Purpose**
- **Overview of Integrated Safety Analysis**
- **Hazard Analysis Approach**
- **External Events – Evaluation and Design**
- **Conclusions, Feedback, Action Plan**

# LEAD CASCADE PROJECT

- **Design, construct and operate a centrifuge test facility with up to 240 machines at a GDP**
  - Modest possession limit with the enrichment limit the same as the GDP
  - Use GDP programs, as appropriate, to facilitate facility licensing
- **Machines will be installed in an enrichment configuration but no enriched product will be withdrawn except for laboratory samples**
  - Product and Tails are recombined and re-fed
- **Operation will provide data on design, operation and reliability to minimize or eliminate risk factors for Commercial Plant**
  - Technical, Regulatory, Financial

# PURPOSE OF MEETING

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- **Present USEC's approach to develop and prepare an Integrated Safety Analysis for the Lead Cascade**
- **Present USEC's plan to evaluate external events in the ISA and the design of the Lead Cascade facility**
- **Obtain NRC feedback on the ISA approach and treatment of external events in the ISA and design**
- **This presentation and NRC feedback will expedite the regulatory review by familiarizing the NRC with our approach in advance of the License Application and ensuring that the Application meets expectations**

# ISA is CENTRAL to the “Safety Program”

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- **§ 70.62 Safety program and integrated safety analysis**

“...Each licensee or applicant shall establish and maintain a safety program that demonstrates compliance with the performance requirements of Sec. 70.61. The safety program may be graded such that management measures applied are graded commensurate with the reduction of the risk attributable to that item. Three elements of this safety program; namely, process safety information, integrated safety analysis, and management measures...”

- **Process safety information**

Information pertaining to the hazards of the materials used or produced in the process, information pertaining to the technology of the process, and information pertaining to the equipment in the process.

- **Integrated safety analysis**

- (i) Radiological hazards
- (ii) Chemical hazards
- (iii) Facility hazards
- (iv) Potential accident sequences caused by process deviations or credible internal and external events, including natural phenomena;
- (v) Consequence and the likelihood of occurrence of each potential accident sequence
- (vi) Item relied on for safety, the characteristics of its preventive, mitigative, or other safety function, and the assumptions and conditions under which the item is relied upon to support compliance with the performance requirements of Sec. 70.61.

- **Management measures**

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# ISA Team

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- **ISA typically prepared by a team of individuals representing the various interested organizations**
- **Team size depends on complexity of facility operations and associated hazards**
- **“Full” ISA team typically consists of the team leader, “core” members, and additional experts as needed**
  - Individuals experienced with centrifuge design, fabrication and operation
  - Individuals experience in hazards & risk analysis and NCS

# Scope of Analysis

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- **Define process and activities**
- **Define Boundaries**
- **Develop Assumptions**
- **Identify Inventory**
- **Identify Modes of Operation**

# Inputs to Hazards Analysis

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- **Facility Design Description**
- **System Design Descriptions**
- **Process Flow Diagrams**
- **Facility layout diagrams**
- **Piping and Instrument diagrams**
- **Bounding Facility Inventory (radiological and chemical)**

# Hazard Analysis Development

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- **Considers all modes of operations :**

- Startup
- Normal
- Off Normal Operation
- Standby
- Maintenance
- Shutdown

- **Consists of two basic activities:**

- Hazard Identification
- Hazard Evaluation

# Hazard Identification

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- **Systematic and comprehensive process designed to identify all known hazardous materials (radiological and chemical) and energy sources**
- **Hazard Identification divided into three steps**
  - Division of facility into sections
  - Facility walkdowns
  - Screening for Standard Industrial Hazards

# Division of the Facility

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- Facilitates hazard identification and evaluation
- Provides more comprehensive analysis
- Sections may be individual unit operations, individual or grouped facility systems, specific functions, and/ or physical boundaries inside the facility

# Facility Walkdowns

- **Include both physical (when possible) and information walkdowns**
- **The purpose of these walkdowns is to identify hazardous materials and energy sources for each facility area**
- **Information walkdowns include a review of:**
  - Facility description
  - Facility inventory
  - Existing safety documentation
  - Facility or Operational Safety Plans
  - Design/system drawings
  - Facility processes and system design - consult with facility experts
- **Team uses a hazards checklist**
- **Resulting list of hazards (radiological and chemical) is documented in Hazard ID tables**

# Hazard Identification Table Sample

Item	Hazard Energy Source or Material	Exists (Y/N)	Description	Disposition
1.0	Electrical			
1.1	Battery banks			
1.2	Cable runs			
1.3	Diesel generators			
1.4	Electrical equipment			
1.5	Heaters			
1.6	High voltage (> 600V)			
1.7	Locomotive, electrical			
1.8	Motors			
1.9	Power tools			

# Screening for Standard Industrial Hazards

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- **Standard Industrial Hazards (SIHs) include those materials or energy sources that are routinely encountered and accepted in general industry and construction**
- **Considered a SIH if national consensus codes or standards exist to govern handling and use**
- **SIHs are evaluated only to the extent that they could act as initiators or contributors to events that result in radiological or hazardous chemical releases**
- **Hazards screened as SIHs are noted in Hazard ID Table with screening criteria in disposition column**

# Examples of Standard Industrial Hazards

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- **Specific materials (e.g., lead and asbestos) that have their own control program**
- **Thermal energy sources (burn potential)**
- **Electrical shock hazards**
- **Gas cylinders transported and stored in approved configuration, within design limit**
- **Personnel pinches, trips, falls, slips, etc.**
- **Confined space hazards**
- **Hazards typically found in office areas**

# Chemical Screening

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- **The lists of chemicals considered to be hazardous are given in:**
  - 29 CRF 1910.119 (TQ)
  - 40 CFR 68 (TQ)
- **A chemical is screened if:**
  - It is on one of the referenced lists but is not present in quantities greater than the values established for that material

# Hazard Evaluation (HE)

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- **Designed to ensure a comprehensive assessment of facility hazards and accidents**
- **Characterizes hazards by considering potential release mechanisms, identifying causes of the release, estimating initiating event frequency, and estimating consequences of the release**
- **Identifies risk and focuses attention on those events that pose unacceptable risk to the public and workers**
- **Identifies potential preventive & mitigating features**
- **Ultimately determines mitigated frequency and consequence level, and mitigated risk**

# Hazard Evaluation Scope

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- **Process events**
- **Natural phenomena, external events, nuclear criticality**
- **Consideration of the entire spectrum of possible events for a given hazard in terms of both frequency and consequence levels**
- **Hazards addressed by other programs and regulations (e.g., PSM, OSHA, RCRA, DOT, EPA) only to the extent that loss of control of the hazard could result in a significant radiological or chemical release**

# Hazard Evaluation Process

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- **Divided into four major steps:**
  - Identification of Initial Conditions
  - Unmitigated Hazard Evaluation
  - Selection of Controls (IROFS) where required
  - Mitigated Hazard Evaluation

# Initial Conditions

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- **Specific conditions that are part of facility operations**
- **Used to establish an analysis reference baseline**
- **Used to clarify a point of analysis**
- **May include and inherently credit specific assumptions, inventory information, or specific passive design features (e.g., facility construction in the prevention of certain accidents)**

# Initial Condition Examples

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- **Facility construction is capable of withstanding a surface vehicle impact without adverse affects on facility operations**
- **Facility and process inventories are limited to that identified in the inventory document**
- **Workers are able to react to obvious hazardous conditions and evacuate**

# Unmitigated Evaluation

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- **Performed to determine risks involved with the facility and its associated operations without regard for safety controls or programs**
- **No credit is taken for preventive or mitigative features other than the specified Initial Conditions**
- **Laws of physics are obeyed**
- **Material at risk will equal the available hazardous inventory that can be acted upon**

# Hazard Evaluation Tables

- **Used to document results of HE process**
- **HE Table information could include:**
  - Event number / Event category
  - Postulated event description (including location and hazard source)
  - Causes
  - Unmitigated frequency level
  - Unmitigated consequence level (onsite and offsite)
  - Unmitigated risk bin

# Example of Unmitigated HE Table

Event No.	Event Category	Postulated Event Description	Causes	Unmitigated		
				Freq. Level	Consequence Level	Risk Rank

# HE Table Details

- **Sequential Event Number**
  - Two or three letter mnemonic identifier
- **Event Category**
  - EC-1 Fire
  - EC-2 Explosion
  - EC-3 Loss of Confinement/Containment
  - EC-4 Direct Rad./Chemical Exposure
  - EC-5 Criticality
  - EC-6 External Events
  - EC-7 Natural Phenomena

# HE Table - Unmitigated Event Frequency Level

- Estimates are largely qualitative
- Based on causes of the event
- Can be determined from engineering judgment or a variety of sources
- Uncertainties accommodated by estimating in the conservative direction

# Quantitative Definitions of Likelihood

Likelihood Level	Acronym	Frequency	Qualitative Description
Not Unlikely	NU	$f \geq 10^{-4}$ /yr	not anticipated to occur during the lifetime of the facility
Unlikely	U	$10^{-5} \leq f < 10^{-4}$ /yr	not likely to occur during the lifetime of the facility
Highly Unlikely	HU	$10^{-6} \leq f < 10^{-5}$ /yr	will probably never occur during the lifetime of the facility

Credible is as defined by NUREG-1520 and generally implies a frequency  $\geq 10^{-6}$  /yr

# Unmitigated Consequence Level

- **Dose or exposure at specified receptor locations based on unmitigated release of hazardous material**
- **Function of**
  - Type and characteristics of the hazard
  - Quantity of hazardous material released
  - Release mechanism
  - Relative location of the release
  - Relevant transport characteristics
- **Evaluated at three receptor locations**
  - Public - Everyone outside the Controlled Area
  - Worker -Controlled Area - Individuals outside the occupied area of the hazard (outside the Restricted Area) but within the boundary of the Controlled Area
  - Worker - Restricted Area - Individuals immediately adjacent to, or in, the occupied area of the hazard (i.e., within the Restricted Area)

# Radiological Release Consequences

- Qualitative or semi-quantitative assessment
- Based on “source term” for the event, i.e., amount of hazardous material that is assumed to be released and subsequently becomes airborne

Radiological Consequence Levels for Evaluated Receptors

Consequence Level (Abbreviation) ↓	Public (Outside Controlled Area)	Worker-CA (Outside Restricted Area; Inside Controlled Area)	Worker - RA (Inside Restricted Area)
High (H)	Acute Dose ≥ 25.0 rem TEDE	Acute Dose ≥ 100.0 rem TEDE	Acute Dose ≥ 100.0 rem TEDE,
Intermediate (I)	5.0 ≤ Acute Dose < 25.0 rem TEDE, or average rad material released over a 24 hr period which exceeds 1.5E-8 uCi/ml in air or 1.5E-3 uCi/ml in water	25.0 ≤ Acute Dose < 100.0 rem TEDE, or average radiological material released over a 24 hour period which exceeds1.5E-8 uCi/ml in air or 1.5E-3 uCi/ml in water	25.0 ≤ Acute Dose < 100.0 rem TEDE,
Low (L)	Acute Dose < 5.0 rem TEDE	Acute Dose < 25.0 rem TEDE	Acute Dose < 25.0 rem TEDE

# Hazardous Chemical Release Consequences

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- Exposure levels due to accidental chemical releases are assessed to determine airborne concentrations at various receptor locations
- Concentrations compared to chemical exposure guidelines for onsite and offsite receptors
- Emergency Response Planning Guidelines (ERPGs) are the selected chemical exposure guidelines

# ERPGs and 10CFR70.61 Performance Requirements

<u>10 CFR70.61 Event Consequence</u>	<u>10 CFR70.61 Receptor</u>	<u>10 CFR70.61 Criteria for Acute Chemical Exposure</u>  "An acute chemical exposure to an individual from licensed material or hazardous chemicals produced from licensed material that:"	<u>Applicable ERPG Definition</u>
High	Public (outside the controlled area)	<i>"could lead to irreversible or other serious, long-lasting health effects."</i>	<b>ERPG-2</b> "The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or <i>developing irreversible or other serious health effects</i> or symptoms that could impair the ability to take protective action"
	Worker	<i>"could endanger the life of the worker."</i>	<b>ERPG-3</b> "The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or <i>developing life-threatening health effects.</i> "
Intermediate	Public (outside the controlled area)	<i>"could cause mild transient health effects."</i>	<b>ERPG-1</b> "The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour <i>without experiencing other than mild transient adverse health effects</i> or perceiving a clearly defines objectionable odor."
	Worker	<i>"could lead to irreversible or other serious, long-lasting health effects."</i>	<b>ERPG-2</b> "The maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or <i>developing irreversible or other serious health effects</i> or symptoms that could impair the ability to take protective action"

# Chemical Consequence Levels

Chemical Consequence Levels for Evaluated Receptors

Consequence Level (Abbreviation) ↓	Public (Outside Controlled Area)	Worker-CA (Outside Restricted Area; Inside Controlled Area)	Worker - RA (Inside Restricted Area)
High (H)	Acute exposure, $C \geq \text{ERPG-2}$ , or intake of $\geq 30$ mg of uranium in soluble form, or which could lead to irreversible or serious long-lasting health effects	Acute exposure, $C \geq \text{ERPG-3}$ , or which could endanger the life of the worker	Acute exposure, $C \geq \text{ERPG-3}$ , or which could endanger the life of the worker
Intermediate (I)	Acute exposure, $\text{ERPG-1} \leq C < \text{ERPG-2}$ , or which could cause mild transient health effects	Acute exposure, $\text{ERPG-2} \leq C < \text{ERPG-3}$ , or which could lead to irreversible or serious long-lasting health effects	Acute exposure, $\text{ERPG-2} \leq C < \text{ERPG-3}$ , or which could lead to irreversible or serious long-lasting health effects
Low (L)	Acute exposure, $C < \text{ERPG-1}$	Acute exposure, $C < \text{ERPG-2}$ , or which could cause mild transient health effects	Acute exposure, $C < \text{ERPG-2}$ , or which could cause mild transient health effects

## Unmitigated Risk Bin

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- Events are “binned” to assess relative risk
- Risk is binned for each receptor (Worker RA, Worker CA, Offsite public)
- Focuses attention on events that pose unacceptable risk to receptors
- High risk events will require additional analysis and/or IROFS

# Risk Binning Matrix, Public

Risk Binning Matrix, Public (Offsite, Outside Controlled Area)

Frequency → Consequence ↓	Highly Unlikely $10^{-6} \leq f < 10^{-5} / \text{yr}$	Unlikely $10^{-5} \leq f < 10^{-4} / \text{yr}$	Not Unlikely $f \geq 10^{-4} / \text{yr}$
<b>High</b> Acute Dose $\geq 25.0$ rem TEDE, or acute chemical exposure, $C \geq \text{ERPG-2}$ , or intake of $\geq 30$ mg of uranium in soluble form, or exposure, or exposure which could lead to irreversible or serious long-lasting health effects	B	A	A
<b>Intermediate</b> $5.0 \leq \text{Acute Dose} < 25.0$ rem TEDE, or average radiological material released over a 24 hour period which exceeds $1.5\text{E-}8$ uCi/ml in air or $1.5\text{E-}3$ uCi/ml in water, or acute chemical exposure, $\text{ERPG-1} \leq C < \text{ERPG-2}$ , or which could cause mild transient health effects	B	B	A
<b>Low</b> Acute Dose $< 5.0$ rem TEDE, or acute chemical exposure, $C < \text{ERPG-1}$	B	B	B



**Region A**  
Unmitigated events falling in Region A require preventive or mitigative controls (IROFS). The desired result is that the mitigated combination of consequence and frequency is moved into the B region.



**Region B**  
Unmitigated events with risk falling in Region B generally have negligible risk and no further action is required. However, the facility may decide to add additional controls for these events based on management decision.

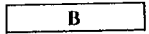
# Risk Binning Matrix, Worker-CA

Risk Binning Matrix, Worker-CA (Outside Restricted Area, Inside Controlled Area)

Frequency → Consequence ↓	Highly Unlikely $10^{-6} \leq f < 10^{-5} / \text{yr}$	Unlikely $10^{-5} \leq f < 10^{-4} / \text{yr}$	Not Unlikely $f \geq 10^{-4} / \text{yr}$
<b>High</b> Acute Dose $\geq 100.0$ rem TEDE, or Acute chemical exposure, $C \geq \text{ERPG-3}$ , or which could endanger the life of the worker	B	A	A
<b>Intermediate</b> $25.0 \leq \text{Acute Dose} < 100.0$ rem TEDE, or average radiological material released over a 24 hour period which exceeds $1.5\text{E-}8$ uCi/ml in air or $1.5\text{E-}3$ uCi/ml in water, or acute chemical exposure, $\text{ERPG-2} \leq C < \text{ERPG-3}$ , or which could lead to irreversible or serious long-lasting health effects	B	B	A
<b>Low</b> Acute Dose $< 25.0$ rem TEDE, or acute chemical exposure, $C < \text{ERPG-2}$ , or which could cause mild transient health effects	B	B	B



**Region A**  
Unmitigated events falling in Region A require preventive or mitigative controls (IROFS). The desired result is that the mitigated combination of consequence and frequency is moved into the B region.



**Region B**  
Unmitigated events with risk falling in Region B generally have negligible risk and no further action is required. However, the facility may decide to add additional controls for these events based on management decision.

# Risk Binning Matrix, Worker-RA

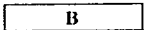
Risk Binning Matrix, Worker-RA (Inside Restricted Area)

Frequency → Consequence ↓	Highly Unlikely $10^{-6} \leq f < 10^{-5} / \text{yr}$	Unlikely $10^{-5} \leq f < 10^{-4} / \text{yr}$	Not Unlikely $f \geq 10^{-4} / \text{yr}$
<b>High</b> Acute Dose $\geq 100.0$ rem TEDE, or Acute chemical exposure, $\geq$ ERPG-3, or which could endanger the life of the worker	B	A	A
<b>Intermediate</b> $25.0 \leq$ Acute Dose $< 100.0$ rem TEDE, or acute chemical exposure, ERPG-2 $\leq$ C $<$ ERPG-3, or which could lead to irreversible or serious long-lasting health effects	B	B	A
<b>Low</b> Acute Dose $< 25.0$ rem TEDE , or acute chemical exposure, C $<$ ERPG-2, or which could cause mild transient health effects	B	B	B



**Region A**

Unmitigated events falling in Region A require preventive or mitigative controls (IROFS). The desired result is that the mitigated combination of consequence and frequency is moved into the B region.



**Region B**

Unmitigated events with risk falling in Region B generally have negligible risk and no further action is required. However, the facility may decide to add additional controls for these events based on management decision.

# Available Controls

- **Available Preventive Features (which reduce likelihood)**
  - design features
  - administrative controls
  - specific safety functions of each
- **Available Mitigating Features (which reduce consequences)**
  - design features
  - administrative controls
  - specific safety functions of each

# Example of Controls in Evaluation Table

Prevention Features		Mitigation Features	
Design	Administration	Design	Administration
Electrical equipment design codes; NFPA standards.	Combustible Material Control Program limits combustibles in area; trained personnel; Standard Operating Procedures; preventive maintenance program includes lubrication of bearings and gears.	Equipment and building design – materials of construction limit combustible material available; fire detection and suppression system; building ventilation system; Combustible Material Control Program.	Emergency Operating Procedures; trained personnel; Fire Department response.

# **Selection of IROFS - Mitigated Hazard Evaluation Phase**

- **Certain preventive and mitigating features are selected as IROFS**
- **Based on preventive IROFS, adjust unmitigated event frequency to a mitigated event frequency**
- **Based on mitigating IROFS, adjust unmitigated consequence levels to mitigated consequences for onsite and offsite receptors**
- **Determine Mitigated Risk Level for each receptor using mitigated event frequency and consequences**

Example Unmitigated/Mitigated HE Table

Table D-1, Hazard Evaluation Tables For Drum Staging Area

Event No.	Event Description	Causes	Freq. Level	Consequence Level	Risk Rank	Preventive Controls	Mitigative Controls	Freq. Level	Consequence Level	Risk Rank
			Init.	Unmitigated	Unmit.	(SF=Safety Function)	SF=(Safety Function)	Prev.	Mitigated	Mit.
SA6-3	Car or truck impacts drum staging areas, breaching drums and releasing radioactive material. Follow-on fire results, fueled from breached vehicle fuel tanks.  Applicable Location: Drum Staging Area  Hazard Source: Pu-239 and other transuranic nuclides.	Driver error, vehicle mechanical failure.	NU	Worker RA: High  Worker CA: Low  Offsite: Low  <u>Note:</u> Unmitigated consequences are based on the release of 325 drums (one half of the drum inventory located in the staging area).	A  B  B	<u>Design:</u> Drum staging area barriers [Staged drum impact protection].  <u>Administrative:</u> <b>Traffic Control Program - Minimizing car and truck access to drum staging areas when waste drums are present [SF: Minimize potential for impact or fire].</b> Includes area speed limits [SF: Provides driver additional reaction time to correct driving errors, Reduces vehicle impact energy].  Trained drivers.  Vehicle preventive maintenance.	<u>Design:</u> Steel drums (those not directly impacted and not located in the fire) [SF: Non-combustible confinement, impact resistant].  Fire-retardant pallets [Limits combustibles]  Staging area construction materials are non-combustible.  <u>Administrative:</u> Emergency Response Procedures [SF: Worker evacuation and sheltering].  Transient Combustible Material Control Program. [SF: Limits combustibles, thereby controlling the spread of the fire].  Use of portable fire extinguishers.  Radiation Protection Program.  Fire Dept. response.	U	Worker RA: Low  Worker CA: Low  Offsite: Low  <u>Note:</u> Mitigated consequences assume combustible material control will help to reduce the number of drums released in the fire, and also assume that worker evacuation and sheltering will give a consequence of Low to the worker.  The credited preventive features help to reduce the frequency of this event to the U frequency range.	B  B  B

# Hazard Analysis Summary

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- **Hazard identification involves a systematic and comprehensive process designed to identify all known hazards**
- **The hazard evaluation process is designed to ensure a comprehensive assessment of facility hazards and accidents**
- **The technique identifies risk and focuses attention on those events that pose unacceptable risk to the public and workers**
- **The purpose of the unmitigated/mitigated approach is to demonstrate that the selected preventive and mitigating IROFS reduce the event risk to a level that meet the 10 CFR 70.61 performance requirements**

# CREDIBLE EXTERNAL EVENTS

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- Regulation requires consideration of potential accident sequences initiated by “natural phenomena” in the ISA
- NUREG-1520 (Section 3.4.3.2) delineates tornadoes, hurricanes, floods, and earthquakes as examples of “natural phenomena”
- NUREG-1520 also states that as a minimum the ISA summary include the following:
  - 100-year flood consistent with US Army Corps of Engineer flood plain maps should be postulated
  - Provide the earthquake accelerations associated with a 250-year and 500-year earthquake
- USEC plans to use the above in the ISA
- The likelihood of the potential accident sequence will be based on the string of events leading to challenges of the Performance Criteria

# DESIGN CRITERIA versus ISA

## § 70.64 Requirements for new facilities or new processes at existing facilities.

(a) Baseline design criteria. Each prospective applicant or licensee shall address the following baseline design criteria in the design of new facilities. Each existing licensee shall address the following baseline design criteria in the design of new processes at existing facilities that require a license amendment under Sec. 70.72. The baseline design criteria must be applied to the design of new facilities and new processes, but do not require retrofits to existing facilities or existing processes (e.g., those housing or adjacent to the new process); however, all facilities and processes must comply with the performance requirements in Sec. 70.61....

...(2) Natural phenomena hazards. The design must provide for adequate protection against natural phenomena with consideration of the most severe documented historical events for the site....”

- **USEC plans to provide “adequate protection” by designing or confirming the design of existing buildings based on accepted engineering practice, local building codes, and applicable national standards**

## Conclusion, Feedback, Action Plan

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- **USEC plans to develop and prepare an ISA using the presented Hazard Analysis approach**
- **USEC plans to use the 100-year flood and the 250-year and 500-year earthquake in the ISA**
- **USEC plans to provide “adequate protection” against natural phenomena by designing or confirming the design of existing buildings based on accepted engineering practice**
- **USEC foresees the following additional pre-application meeting:**
  - late-May to discuss Security Plan submittal
  - July to discuss preliminary results of Environmental Report and ISA